ANSWERS

Last new thing for this unit: Using Empirical formula to find actual Molecular Formula

Name _____

Period _____

the test is Thursday

1. Given info: A colorless, poisonous, sweet-tasting clear liquid has 18.015g C, 4.545g H, and 24.00 g O. It's molecular weight is 62 g/mole.

Find the empirical formula

$18.015\text{g C} \times \left(\frac{1\ \text{mol C}}{12.01\ \text{g C}}\right) = 1.5\ \text{mol C}$

$4.545\text{g H} \times \left(\frac{1\ \text{mol H}}{1.01\ \text{g H}}\right) = 4.5\ \text{mol H}$

$24.00\text{g O} \times \left(\frac{1\ \text{mol O}}{16\ \text{g O}}\right) = 1.5\ \text{mol O}$

ANSWER $C_1H_3O_1$

Find what the mass would be for a mole of this **empirical** formula. $C_1H_3O_1$

$1 \times 12.01\ \text{g/mole} = 12.01$

$3 \times 1.01\ \text{g/mole} = 3.03$

$1 \times 16.00\ \text{g/mole} = 16.00$

$31.04\ \frac{\text{grams}}{\text{mole}}$

Now randomly choose a few integers and multiply your empirical mass by them.

31.04 ×2 → 62.08 ← the molecular formula is $C_2H_6O_2$

31.04 ×3 → 93.12

Write the molecular formula here _____

substance A	C_2H_4	$C_{10}H_{40}$
substance B	C_2H_2	$C_{10}H_{10}$
substance C	C_3H_4O	C_3H_4O

2. The first column shows (molecular / empirical) formulas.
3. The second column shows (molecular / empirical) formulas.

4. What is the % by mass of oxygen in $Mg(NO_3)_2$? (2)

→ find total mass

→ find oxygen mass

$\frac{96\text{ g oxygen}}{148.33\text{g total}} \times 100 = 65\%$

(3)

5. Given info: You buy a used car and in the trunk find an Tupperware tub with a substance. When analyzed it has 6.93g of oxygen and 0.43 g of hydrogen. If the molar mass of the compound is 34.0 g/mole, what is the molecular formula?

Find the empirical formula

$6.93 \text{ grams } O \times \left(\frac{1 \text{ mole } O}{16.00 \text{ g } O}\right) = 0.433 \text{ moles } O$

$0.43 \text{ g } H \times \left(\frac{1 \text{ mol } H}{1.01 \text{ g } H}\right) = 0.426 \text{ moles } H$

answer: O_1H_1

Find what the mass would be for a mole of this **empirical** formula.

oxygen: $1 \times 16.00 = 16.00$

hydrogen: $1 \times 1.01 = 1.01$

17.01 g/mole

Now randomly choose a few integers and multiply your empirical mass by them.

$\times 1 = 17.01$

times two $= 34.02$

times three $= 51.03$

Write the molecular formula here O_2H_2

(4) 6. What is the empirical formula of a carbon-oxygen compound, given that a 95.2 g sample of the compound contains 40.8 g of carbon and the rest oxygen?

$40.8 \text{ g } C \times \left(\frac{1 \text{ mole } C}{12.01 \text{ g } C}\right) = 3.40 \text{ g } C$

If the total and the carbon are subtracted, it gives the oxygen mass of the sample: $95.2 - 40.8 = 54.4$ grams

$54.4 \text{ grams } O \times \left(\frac{1 \text{ mol } O}{16.00 \text{ g } O}\right) = 3.40 \text{ moles } O$

$C_{3.40}O_{3.40} \rightarrow C_1O_1$

(5) 7. A sample of iron oxide was found to contain 1.116 g of iron and 0.480 g of oxygen. Its molar mass is roughly 5 x as great as that of oxygen gas. Find the empirical formula and the molecular formula of this compound.

Careful! Oxygen gas looks like this! O=O and is 32.0 grams/mole

$5 \times 32 = 160\ g/mol$ this is the molar mass

$1.116\ g\ Fe \times \left(\frac{1\ mole}{55.85\ g\ Fe}\right) = 0.0200$

$0.480\ g\ O \times \left(\frac{1\ mol\ O}{16.00\ g\ O}\right) = 0.0300$

Fe_2O_3

$2 \times 55.85 = 111.7$
$3 \times 16.00 = 48.0$
$159.7\ g/mole$

Answer
Molec Formula is
Fe_2O_3

Key to understanding the cartoons on this sheet:				
1 chlorine atom	1 hydrogen atom	1 oxygen atom	1 nitrogen atom	1 carbon atom
⊕	●	○	◍	◍

(6) 8. Calculate the molecular mass of the molecule shown at the left. Formula: $C_3O_3H_8$

$3 \times 12.01 = 36.03$
$3 \times 16.00 = 48.00$
$8 \times 1.01 = 8.08$
$92.11\ g/mol$

(8) (7) 9. What is the molecular mass of $Fe_2(CO_3)_3$.

$2 \times Fe = 2 \times 55.85 = 111.7$
$3 \times C = 3 \times 12.01 = 36.03$
$9 \times O = 9 \times 16.00 = 144.00$
$291.73\ grams/mole$

4	4(2) 2
5	5(3) 3
5	5(3) 4
5	6(4) 5
8	7(5) 6
6	7(5) 6
7	8(6) 7
7	9(7) 8
7	